ARS BEES & POLLINATION RESEARCH

A FIVE - YEAR STRATEGIC & OPERATIONAL PLAN

October 1997 *

Vision and Mission Accomplishment Through Team Work

* Modified July, 1998 to include the small hive beetle research

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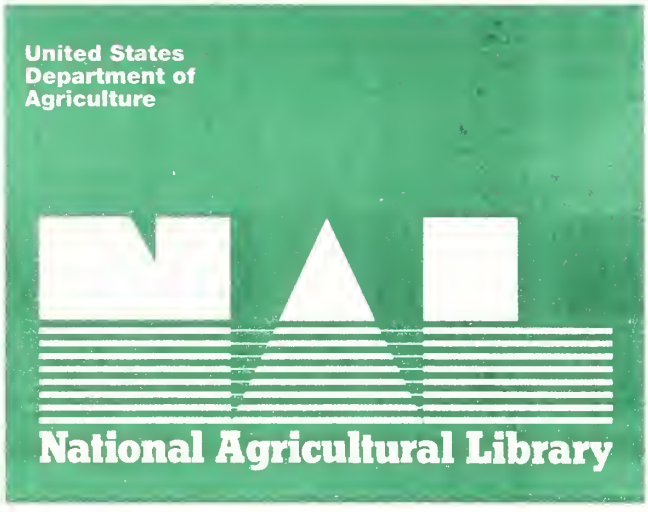
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Foreword

This Strategic and Operational Plan (SOP) represents the collective efforts of the National Program Leader, the Research Leaders, and the scientists of the Agricultural Research Service (ARS) bees and pollination research program. It serves as a strategic and operational guide to ARS's five bee research management units (MUs) and establishes their vision and mission. The development of this SOP is in keeping with the scope and intent of the Government Performance and Results Act of 1993, which was passed by Congress for the purpose of upgrading, planning, and management of the Federal departments and agencies; improving the public confidence in Federal agencies; improving program effectiveness, efficiency, and public accountability; improving service delivery; and improving Congressional decision-making. The SOP is intended to be used for implementing the vision and mission of the ARS Bees and Pollination Research.

Specifically, the strategic plan will be used to:

- Lay the foundation for meeting the research needs of the clients who use agriculture research.

- Serve as a basis for selecting proposed research activities within the program and for periodic appraisal of the most effective way to organize the program's management; as a basis for monitoring and evaluating program progress; as a basis for developing budget estimates and allocating resources within the program to promote scientific excellence; and as a basis for helping to coordinate the research with other intramural and extramural programs while ensuring that such efforts are efficient and complementary.

- Communicate with policy and decision-makers at the Federal and State levels.

- Communicate with the customers of ARS bees and pollination research laboratories and provide an opportunity for their input.

- Facilitate the development of partnerships and linkages with other Federal, State, industry, and private institutions and other organizations in areas of common interest.

- Serve as an instrument to help maintain the resolve of Congress and stakeholders for ARS bees and pollination research laboratories.

The ARS National Program Staff expresses its gratitude and appreciation to all the strategic planning workshop attendees for their participation and their help in formulating this strategic and operational planning document.

S. Karl Narang
National Program Leader

Executive Summary

A major priority of the Agricultural Research Service (ARS) is the development and subsequent transfer to customers of environmentally-friendly, economical, and publicly-acceptable methodology to maintain an adequate supply of bees for pollination and honey production. The discovery of *Acarapis woodi*, the tracheal mite, in 1984, *Varroa jacobsoni* in 1987, and the Africanized honey bee in 1990 has significantly reduced the population of managed and unmanaged bees in the United States. These problems have been further aggravated by severe winters, the high cost of maintaining managed colonies because of parasitic mites, and low honey prices. Consequently, a Bee Research Program Review was held in Beltsville, Maryland on November 12-13, 1996 to evaluate whether the ARS bee research was focused on the priorities and needs of our customers, stakeholders, beneficiaries and partners.

The purpose of the Review was to: 1) evaluate the overall mission and scope of bee and pollination research; 2) identify major areas of emphasis for future research; 3) identify new customers, the changing needs of existing customers, and new opportunities in scientific methods; 4) develop a 5-year strategic and operational plan for bee and pollination research; 5) explore opportunities for new partnerships; and 6) strengthen the cooperative research concept. Participants included the customers, stakeholders, beneficiaries, partners, professional and scientific support staff, and the ARS National Program Staff (see List of Participants, Appendix 3).

Sets of scientific and technological goals including a number of specific objectives and tasks as well as projected milestone achievements with estimated completion dates were established. Each of the specific tasks were categorized into one of three types of efforts: 1) main effort (ME) which describes the most plausible tactic for successful achievement of the strategic goal;
2) activities which enhance or optimize the potential of the effort but are lower priority than ME;
3) high risk research, which could contribute substantially toward achieving the strategic goal if successful, or research generally considered innovative and exploratory.

For each strategic goal, an operational (tactical) plan has been included that identifies the specific responsible scientist(s) for that activity over a five-year period. These operational plans are intended to facilitate teamwork and technology transfer, and to serve as a "roadmap" for achieving the strategic goals. The operational plans are dynamic and will be reviewed for progress on an annual basis.

The **vision** of bee and pollination research is to ensure the availability of an adequate supply of bees for pollination and honey production.

The **mission** of bee and pollination research is to identify and develop new technologies leading to environmentally sustainable integrated management strategies for pests of bees, to identify new opportunities to use bees as pollinators to increase crop production, and to maintain an adequate living standard for providers of bees for pollination and honey producers.

The major focus areas identified at the review included: 1) economic control of the parasitic mites, *Varroa jacobsoni* and *Acarapis woodi;* 2) mitigation of the impact of the Africanized honey bee; and 3) enhanced pollination using *Apis mellifera* and non-*Apis* bees.

The key primary pests are parasitic mites, American foulbrood disease, and the Africanized honey bee. Other pest problems addressed include chalkbrood disease, virus diseases, the greater wax moth, and the small hive beetle.

1) High-priority strategic goals were assigned to the following needs:

2) Control of parasitic mites, bee diseases and other pests.

3) Develop technology to mitigate the impact of the Africanized honey bee.

4) Enhance existing and develop new pollination strategies.

5) Improve bee management.

6) Provide service needs to ARS customers, beneficiaries, stakeholders and partners.

ARS scientists shared their research activities with the participants and also received their input as to the current and future research needs that could be met by ARS.

Following the development of an initial version of this document in November 1996, a second work session was held in Beltsville, MD, December 11-12, 1997 with Research Leaders and selected scientists. The purpose of this second meeting was to assess the adequacy of the document and to make additions and modifications to it in response to changes in program and staff which occurred during 1997.

Introduction

The ARS Bees and Pollination Research provides new and improved knowledge and field-use technologies that can be used to enhance crop yields, quality of plants and plant communities, and to optimize production efficiency. This research enhances knowledge of the effects of insect ecology and behavior on pollination, methods for improved management of bee pollinators of major agricultural crops, and pollination strategies for different geographical regions. The research also provides technology for acquiring a dependable supply of non-*Apis* bees as pollinators of major agricultural crops and for the enhancement of their commercial use for reliable and cost-effective pollination of vegetable and fruit crops, specialty seed crops, and other high value horticultural crops. Technology for rapid detection and control of parasitic mites, wax moths, small hive beetles, chalkbrood and American foulbrood diseases helps in increasing hive vigor and enhancing pollination efficiency and honey production. Additionally, this research provides new knowledge of the pollination needs of new plants and crops, as well as produces ecologically sound and cost effective methods for increasing productivity and quality of new crops.

Bees help to maintain competitiveness of U.S. agriculture in the world market by increasing the yields and quality of over 90 cultivated crops whose annual value is estimated to exceed 10 billion dollars. Honey bees directly contribute over $250 million to U.S. agriculture by the production of honey and beeswax. Tens of millions of dollars are likewise contributed to the U.S. economy from the sales and management of alfalfa leafcutting bees. Federal bee research began over 100 years ago as a one-person program. Today there are five ARS bee research laboratories located in Baton Rouge, LA; Beltsville, MD; Logan, UT; Tucson, AZ; and Weslaco, TX. Federal bee research has had a very productive history. Some of the important accomplishments of this research include:

- Development of the first apparatus for honey bee queen insemination.
- Development of the use of fumagillin, an antibiotic for the control of the honey bee protozoan disease caused by *Nosema apis*.
- Development of the antibiotic extender patty for delivery of Terramycin (oxytetracycline HCl) to honey bees for the prevention and control of American foulbrood disease.
- Co-development of management technology for the use of alfalfa leafcutting bees and alkali bees for the production of alfalfa seeds in the western U.S.
- Development of chemical tests to detect adulterated honey.
- Establishment of *Osmia cornifrons* in the northeastern U.S. and *Osmia lighariain* in the western U.S. for the pollination of small fruit orchards.
- Maintenance of a diagnostic service for honey bee diseases and pests since 1898.
- Documentation of the presence of Terramycin-tolerant strains of *Bacillus larvae* in U.S. honey bee colonies.

- Discovery of the presence of chalkbrood disease in honey bees in the U.S.

- Demonstration of the role of non-pathogenic microorganisms associated with honey bees in honey bee nutrition and disease control.

- Documentation of the adverse consequences of pesticide use on honey bee colonies, specifically, the effects of Penncap-M, fenthion, and acephate, and sublethal levels of pesticides and insect growth regulators.

- Discovery of the first infestation of *Acarapis woodi* in North American honey bees.

- Discovery of the first evidence of the resistance of *Varroa jacobsoni* to fluvalinate.

- Discovery that defensive behavior of Africanized honey bees (AHB) is inherited via drones.

- Discovery that chalkbrood disease in honey bees can be controlled by selecting bee stocks for hygienic behavior. Bee breeders are beginning to select breeding stock for this trait.

- Development of swarm traps to monitor the spread of AHB and to control AHB in high-use public and recreational areas.

- Publication of Insect Pollination of Cultivated Crop Plants. USDA Agricultural Handbook No. 496, 411 pp. 1976.

- Development and release of ARS Y-C-1, a tracheal mite-resistant honey bee stock.

- Development of ethylene oxide, high- and low-temperatures, and high velocity electron beams for use in integrated pest management programs that allow reuse of honey bee equipment without the risk of spreading disease organisms.

- Development of the Universal System for the Detection of Africanized honey bee – Identification (USDA-ID) and the Fast Africanized Bee Identification System(FABIS) that are used by APHIS to identify AHB.

- Development of a formic acid gel for the control of the parasitic mites, *Varroa jacobsoni* and *Acarapis woodi.*

- Development of supportive research leading to the EPA- registration of Apistan, Amitraz, and menthol.

- Determination that different development times in African and European honey bee queens leads to the Africanization of European honey bees.

- Development of new and improved management practices which increase alfalfa leafcutting bee production in the U.S.

- Demonstration of the effectiveness of the blue orchard bee as a pollinator of commercial-scale cherries, apples and almonds.

- Demonstration of the effectiveness of alfalfa leafcutting bees for the production of hybrid carrots and onion seed.

- Demonstration that inbreeding depression and loss of brood viability is linked to sex alleles in honey bees. This discovery led to breeding schemes that reduce loss of viable hybrid bee colonies.

- Characterization of AHB biology and behavior in terms of defensive behavior, honey production, and difficulty in managing AHB as a pollinator; and showed susceptibility to diseases and pests in AHB to be comparable with that in the European honey bee.

- Development of methods to control open matings in areas occupied by AHB to produce European honey bee queens.

- Demonstration of the genetic variation of *Varroa jacobsoni* and the probability of multiple introductions of the mite to U.S. honey bee populations.

- Demonstration that resistance to *Varroa* mites was a heritable characteristic that could be used in honey bee breeding programs.

Research on bees and pollination has had a major impact on beekeeping in the U.S. Specifically, research on pollination, Africanized honey bees, control of diseases and parasitic mites, and honey chemistry has helped maintain U.S. leadership in beekeeping worldwide. The partnership of federal and state bee research has ensured the availability of bees for pollination and honey production despite the negative impact of tracheal and *Varroa* mites, and of Africanized honey bees.

The ARS Bees and Pollination Research Program Review was held in Beltsville November 12-13, 1996 with ARS bee research scientists and invited partners, customers and stakeholders. The participants grouped the research projects according to five Strategic Goals and prioritized the research projects in each Strategic Goal as: (1) main effort (highest priority), (2) activities that enhance or optimize the effort (second priority), or (3) high risk research (third priority). The highest priority research recommendations in Strategic Goals 1 – 4 were: 1) development of improved methods that are economical for the control of parasitic mites of honey bees; 2) development of new strategies to control American foulbrood disease of honey bees and retard the development of resistance to Terramycin; 3) development of methods to enhance bee pollination utilizing the most appropriate species; 4) development of easy-to-use and economical methods of requeening honey bee colonies; 5) documentation and definition of causative factors contributing to problems of honey bee colony viability; 6) development of new knowledge of mite biology resulting in improved mite control strategies in honey bee management systems; 7) development of mite-resistant honey bee stock(s); 8) development of method(s) for honey bee germplasm preservation; 9) improvement of knowledge about honey bee nutrition; and, 10) improvement of knowledge about population dynamics of AHB.

For the short- and mid-term research needs identified in the second priority, the recommendations included: 1) development of improved methods that are economical for the control of honey bee bacterial diseases; 2) development of new methods that are economical for the control of chalkbrood disease in honey bees; 3) development of new methods that are economical for the control of the wax moth; 4) development of methods to mitigate effects of insecticides on bees; and, 5) development of methods to preserve bee biodiversity.

Research needs for the short- and mid-term in the third priority included: 1) development of improved methods for honey bee breeding; 2) development of improved methods for the identification of the AHB; 3) development of easy-to-use and safe methods for destroying unwanted honey bees in beehives; and, 4) determination of economic impact of virus-induced honey bee diseases.

In Strategic Goal 5 (service needs), the highest priority was given to technology transfer, that would ensure the timely shift of new knowledge, methods and technology to user groups. The second priority was given to: 1) identification of honey bee diseases; 2) taxonomic identification of non-*Apis* bees; and, 3) release of an ARS Bee Bibliography. The third category for service priorities was given to Apiary inspectors' training for disease diagnosis and identification of the AHB.

The recurring message from our customers and stakeholders was the need to increase profitability for the beekeepers, alfalfa seed producers, and orchardists. The cost of producing and maintaining quality colonies for pollen and honey production in the U.S. has increased dramatically since 1984, primarily because of the occurrence of two parasitic mites, *Acarapis woodi* and *Varroa jacobsoni*. Alternative, economical methods for disease and mite control need to be developed. Currently only one biocide is approved for the control of American foulbrood disease (oxytetracycline HCl), *A. woodi* (menthol), and *V. jacobsoni* (fluvalinate). The development of resistance to any currently approved chemical would have a devastating effect on the honey bee industry. In addition, our customers and stakeholders indicated the need to develop non-*Apis* pollinators that would help ensure an adequate and diversified supply of pollinators for U.S. agriculture. On some crops, non-*Apis* bees are the pollinators of choice, however honey bees and non-*Apis* bees are NOT mutually exclusive, rather they can supplement the pollination activity of each other.

The final recommendation was for ARS to increase its communications with their customers and stakeholders by holding periodic program reviews, similar to the one held on November 12-13, 1996, to ensure the applicability of its research.

Vision and Mission Statements

The overall objective of the ARS Crop Production National Program (NP 305), to which bees and pollination research is assigned, is to develop, evaluate, and facilitate implementation of integrated crop production, agricultural engineering, and pest management technologies for sustainable cropping systems. The specific objective of Bees and Pollination Research is to develop and integrate new knowledge and methods for crop pollination and insect pollinator protection with traditional and new crop production and protection systems.

Vision

Ensure the availability of an unlimited supply of healthy bees for cost-effective pollination of cultivated crops, including new crops, as well as wild plants necessary for maintenance of a well-balanced ecosystem, and production of honey and other bee-derived products.

Mission

The mission of the ARS Bees and Pollination Research Program is to develop and demonstrate the application of new and improved knowledge and technology that will help maintain the worldwide competiveness of the U.S bee industry with regard to pollination-dependent food plant productivity and other bee-derived products. ARS will develop effective, environmentally-sound and economical management strategies for crop pollination that will result in increased pollination efficiency, honey production, and better management of the Africanized honey bee, disease organisms, and parasites of pollinators.

Mission of Management Units

Bee Research Laboratory, Beltsville, MD

The Bee Research Laboratory (BRL) conducts research on the biology and control of honey bee (*Apis mellifera* L.) diseases, parasites and pests to ensure an adequate supply of bees for pollination and honey production. Specifically, scientists conduct research on two parasitic mites, *Acarapis woodi* and *Varroa jacobsoni*; American foulbrood and chalkbrood disease; and the greater wax moth. Additionally, scientists conduct research on the molecular characterization of honey bee genetic diversity, and *in vitro* preservation of honey bee germplasm. The BRL also conducts research on the utilization of non-*Apis* bees for the pollination of crops of economic importance. Because of the research specialties, BRL scientists provide authoritative identification of Africanized honey bees and diagnosis of bee diseases and pests for Federal and State regulatory agencies and beekeepers on a worldwide basis.

Subtropical Agricultural Research Center (SARC), Beneficial Insect Research Unit (BIRU), Weslaco, TX

The mission of this research is to develop scientific knowledge and biologically-based technology using mass propagation and augmentative releases/application of natural enemies for control of key insect and mite pests and to develop technology for managing honey bees in the presence of Africanized honey bees and parasitic mites. The BIRU addresses high priority research within the ARS. Numerous cultivated crops and wild plants are pollinated by wild and domesticated honey bees, yet numbers of these colonies are declining rapidly due primarily to parasitic mites and the Africanized honey bee. SARC scientists are well positioned to make substantial progress in addressing these issues.

Carl Hayden Bee Research Center, Honey Bee Research Unit, Tucson, AZ

The Honey Bee Research Program emphasizes studies of basic biology and behavior leading to enhancement of crop pollination. The research program includes: 1) pollination ecology and colony foraging dynamics of bees in crop ecosystems; 2) biochemistry and physiology of bees to determine requirements for individual/colony growth, development and reproduction; 3) role of mites and microorganisms in the physiology of bees and degradation of toxins in the colony; 4) the biology and management of feral Africanized honey bees; 5) behavior of bees including modes of communication, structure and function of sensory receptors and identification and role(s) of pheromones; 6) development of computer simulation models; and 7) remote sensing using radar, microwave frequencies and other techniques to monitor activities of bees.

Honey Bee Breeding, Genetics, & Physiology Laboratory, Baton Rouge, LA

The mission of the USDA-ARS Honey Bee Breeding, Genetics and Physiology Laboratory is to improve honey bee stock and honey bee management related to stock improvement. This broad mission includes components related to problems caused by *Varroa* mites, tracheal mites and Africanized honey bees. The devastating problems caused by *Varroa* mites and the serious problems caused by tracheal mites are targeted as most critical. Scientists are engaged in breeding and testing honey bees for resistance to mites, evaluating mite-bee interactions to better describe breeding criteria, and evaluating stock production processes to explore and solve stock production problems caused by mites.

Bee Biology & Systematics Laboratory, Logan, UT

Research focus is international in scope and primarily involved with addressing crop pollination issues and non-honey bee management problems. Research emphasis is devoted to the development of a more diversified and stable pollinator base for U.S. agriculture. Cross pollinated crops not effectively pollinated by honey bees, avocados for example have and are being targeted for study as well as almonds, alfalfa seed, and canola, carrot, and onion hybrid seed. Continuing research includes: developing viable management programs for commercial-sized populations of alfalfa leafcutting bee, alkali bee, and blue orchard bee; developing control programs for pests and diseases; and evaluating pollination efficacy on "new" crops. The candidacy of various pollinator species continues to be evaluated on targeted crops. The systematics of taxa that show promise as crop pollinators continue to be emphasized. Efforts are also being made to initiate a program emphasizing studies of pheromones that control gregarious nesting habits of soil-nesting bees, especially those species already proven to be known pollinators of agricultural crops.

Customers, Beneficiaries, Stakeholders, and Partners

The bee research laboratories have a long list of customers, beneficiaries, stakeholders, and partners. We have tried to categorize the organizations, however, we realize that the same organization can be a customer, beneficiary, stakeholder, and partner. Customers are individuals or organizations that may directly use the results of bee research. Beneficiaries are individuals or organizations whose well-being may be enhanced by the results of bee research. Stakeholders are organizations or individuals that have an interest in bee research but may not directly benefit from bee research. Partners are individuals and organizations that the bee laboratories work with in collaborative efforts.

Customers

- Arizona Structural Pest Control Board
- The Almond Board of California
- American Bee Breeders Association
- American Beekeeping Federation
- American Honey Producers Association
- Apiary Inspectors of America
- California Bee Breeders Association
- Congress
- Eastern Apicultural Society
- Honey Market News
- International Apple Institute
- International Pollination Systems
- News media
- Ocean Spray Cranberries, Inc.
- Other ARS laboratories
- Pest Control Companies
- Seed Production Companies
- United Fresh Fruit & Vegetable Association
- USDA – Animal and Plant Health Inspection Service (APHIS)
- USDA – Cooperative State Research, Education, and Extension Service (CSREES)
- Western Apicultural Society
- Western Growers Association

Beneficiaries

- Bee Supply Dealers
- Canadian Association of Proffessional Apiculturists
- Canadian Honey Council
- Consumers
- Department of Interior – Bureau of Land Management
- Department of Interior – National Park Service
- Environmental Protection Agency
- Food and Drug Administration
- The National Honey Board
- National Honey Packers & Dealers Association
- Nature Conservancy – International
- Nature Conservancy – National
- USDA - Forest Service

Stakeholders

- American Apitherapy Association
- American Farm Bureau Federation
- American Medical Association
- American Museum of Natural History
- Arizona Intertribal Council
- Foreign Agricultural Organization (FAO)/ Agriculture and Industrial Development (AID)
- Libraries/information services
- National Association of State Departments of Agriculture
- National Plant Board
- National Science Foundation
- Smithsonian Institution

Partners

- American Association of Proffessional. Apiculturists
- Arizona State University
- Binational Agricultural Research and Development Fund (BARD)
- Cornell University
- Johns Hopkins University
- Georgetown University
- Louisiana State University
- Montana State University
- National Institutes of Health
- Oregon State University
- Ohio State University
- Pennsylvania State University
- The State University of Rutgers
- Texas A&M University
- University of Arizona
- University of California
- University of Delaware
- University of Florida
- University of Idaho
- University of Maryland
- University of Minnesota
- University of Montana
- University of Nebraska
- University of Tennessee
- University of Vermont
- University of Wisconsin
- Utah State University
- Washington State University
- Xerces Society

Benefits and Impacts:

- **APHIS** – We provide research data and technology which allows the development of action programs for pest management and plant protection programs. In addition, ARS provides emergency identification of Africanized honey bees for port interceptions.
- **Beekeepers** – We conduct research on the identification and control of bee diseases and pests and provide mite-resistant bee stocks.
- **National Growers Association** – We provide research on the pollination requirements of fruits, vegetable, oil seeds, and nuts to increase the quantity and quality of the crops.
- **Congress** – We provide information and data on the status of projects, planning, and resource needs that aid in developing legislation.
- **National Plant Board** – We assist states in providing information on the biology and control of bee diseases, parasitic mites, and provide emergency identification of the Africanized honey bee.
- **News Media** – We provide information to the news media and the electronic media on our research and to ensure public safety.
- **Academia** – We cooperate with universities and colleges by providing a partnership to conduct research of mutual interest.
- **Federal Regulatory Agencies** – We assist the Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) by providing expertise in the approval of materials for the prevention and control of bee diseases and pests. We support Federal Land Managers who wish to conserve native pollinators.

Disciplines and Focus

Bees and Pollination Research requires not only a knowledge of the animal sciences, but also a knowledge of plant sciences. Each of the bee laboratories has a primary focus -- bee breeding and genetics, bee diseases and parasites, managing the Africanized honey bee, pesticide research and *Apis* and non-*Apis* pollination. Each of the laboratories must also have bee husbandry specialists. Because of the wide-latitude bees and pollination encompasses, team research (intra- and inter-) laboratory is a necessity.

It was evident that the research in some laboratories could be refocused. Duplication of effort must be minimized. A major need identified by the participants of the USDA National Bee Research Program Review was to determine the factors contributing to the loss of honey bee colony viability. This is a major multi-year undertaking that will require the cooperation of several SYs in two or more laboratories. A project coordinator should be appointed to begin planning the research.

Disciplines We Use

- Entomology, chemistry, parasitology and acarology.
- Biological control and insect pathology
- Insect chemical ecology and general ecology
- Plant ecology
- Classical and quantitative genetics, molecular biology, and plant breeding
- Virology
- Bacteriology
- Mycology
- Organic chemistry
- Toxicology
- Behavioral biology
- Botany
- Systematics
- Physics
- Systems science
- Immunology

Our Major Focus Areas

- Crop pollination
- Pollinator-plant relationship
- IPM systems
- Formulation technology
- Computer simulation models
- Bee stock selection
- Acaricide screening
- Mitigating the impact of the Africanized honey bee
- Honey bee germplasm maintenance
- Residue analysis
- Conservation of bees and rare plant
- Bee Systematics
- Insect population dynamics

Primary Bee Diseases, Viruses Affecting Bees, Pest and Parasite Targets, Crops and Beneficial Bee Pollinators We Use

Primary Bee Diseases

- American foulbrood disease
- Chalkbrood disease

Viruses Affecting Bees

- Kashmir bee virus
- Acute bee paralysis virus

Pest Targets

- *Varroa jacobsoni*
- *Acarapis woodi*
- Wax moths
- Small Hive Beetle

Beneficial Bee Pollinators

- *Apis mellifera*
- *Megachile rotundata*
- *Osmia lignaria*
- *Osmia cornifrons*
- *Osmia bucephala*
- *Osmia ribifloris*
- *Andrena fenningeri*
- *Anthophora pilipes villosula*
- *Xylocopa spp.*
- *Bombus spp.*
- *Megachile addenda*
- *Colletes spp.*
- *Habropoda spp.*
- *Nomia melanderi*
- *Eumegachile pugnata*
- *Chalicodoma spp.*

Crops

- Alfalfa Seed
- Almond
- Apple
- Avocado
- Blueberry
- Buckwheat
- Canola
- Carrot
- Cherry
- Clover
- Cotton
- Cranberry
- Eggplant (Greenhouse)
- Melons
- Onion seed
- Pear
- Plum
- Pumpkin
- Soybean
- Squash
- Sunflower
- Tomato (Greenhouse)
- Watermelon
- New Crops

Strengths and Weaknesses of ARS Bee Research Program

Strengths

- Maturity/experience and multi-disciplinary staff
- Accessibility to state-of-the-art equipment
- Good cooperation with producers/commodity groups
- Broad-based staff for multifaceted research
- Adequate physical facilities
- Strategically located laboratories
- Excellent computer support
- Excellent statistical support
- Excellent international cooperative research

Weaknesses

- Declining number of scientists
- Budgetary constraints
- Inadequate technical support due to financial constraints
- Maturity of scientific staff and lack of funding for replacements

Strategic Goals

1. Control of Parasitic Mites, Bee Diseases, and Other Pests
2. Africanized Honey Bee Management
3. Enhancement of Bee-Mediated Crop Pollination
4. Improve Bee Management
5. Provide Service Needs

Strategic Goal 1. – Parasitic Mites, Bee Diseases and Other Pests

Develop cost effective and environmentally friendly methods for the management of parasitic mites, bee diseases and pests including the selection and propagation of bee stocks that show resistance to the parasitic mites.

A. Current Situation

Only two materials are registered for the control of parasitic mites of honey bees, menthol for the control of *Acarapis woodi* and fluvalinate for the control of *Varroa jacobsoni*. These parasitic mites result in economic losses to beekeepers -- Also the cost of control chemicals and colony losses have seriously reduced the profitability of beekeeping and threaten the availability of high quality honey bee colonies. Only one antibiotic, Terramycin, is approved by the Food and Drug Administration for the prevention and control of American foulbrood disease. Recently, in the Midwest, American foulbrood disease seemed to recur as a result of increased tolerance of *Bacillus larvae* to Terramycin which has been used for almost 40 years. Alternative materials need to be developed for the prevention and control of this disease.

B. Desired State

New materials and delivery systems for the management of bee diseases and pests must be continually developed so that beekeepers can rotate antibiotics and acaricides to retard the development of resistance. Mite-resistant honey bee stocks must be developed for use with integrated pest management programs to reduce reliance on chemical controls and to increase the profit margin for beekeepers.

Activities	Activity Code*	Location Code**
1.A. **Control of Parasitic Mites**		
1.A.1. Test synthetic materials for mite control	ME	B,W
1.A.2. Test natural materials for mite control	ME	B,T,W
1.A.3. Develop mite-resistant honey bee stocks	ME	BR
1.A.4. Mite biology as it relates to control	ME	BR,T,W
1.A.5. Mite Rearing	HR	B
1.A.6. Mite resistance to acaricides	ME	B,W
1.B. **American Foulbrood Control**		
1.B.1. Evaluate tylosin	ME	B
1.B.2. Evaluate lauric acid	ME	B
1.B.3. Monitor for Terramycin resistance	ME	B
1.C. **Control of other Diseases and Pests**		
1.C.1. Develop methods to control chalkbrood	E/O	B,T,L
1.C.2. Develop methods to control wax moths	E/O	B,T
1.C.3. Parasitic mite syndrome and bee viruses	HR	B
1.C.4. Small Hive Beetle	ME	B,W

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*Activity Code Key

(ME) = Main effort which describes the most plausible tactic for successful achievement of the strategic goal.

(E/O) = Activities which enhance or optimize the potential of the effort/lower priority than ME.

(HR) = High risk research which could contribute substantially toward achieving the strategic goal if successful. Research generally considered innovative and exploratory.

**Location Code: [B] = Beltsville, [W] = Weslaco, [T] = Tucson, [BR] = Baton Rouge, [L] = Logan.

C. Operational Plan for Strategic Goal 1. Control of Parasitic Mites, Bee Diseases and Other Pests.

Research Approaches	Activities: Year 1	Year 2	Year 3	Year 4	Year 5
1.A. Control of Parasitic Mites					
1.A.1. Test synthetic materials for mite control. (Eischen, Kochansky, Pettis, Shimanuki, Wilson)	Identify & screen candidate compounds for efficacy in caged studies.	Formulate & develop delivery systems.	Field testing.	Continue field testing.	Technology transfer.
1.A.2. Test natural materials for mite control. (Eischen, Elzen, Feldlaufer, DeGrandi-Hoffman, Kochansky)	Identify & screen candidate compounds for efficacy in caged studies.	Formulate & develop delivery systems.	Field testing.	Continue field testing.	Technology transfer.
1.A.3. Develop mite-resistant honey bee stocks. (Rinderer, Harbo, Danka, Sylvester)	Establish selection criteria & procedures; identify candidate bee sources.	Evaluate candidate bees; select breeders.	Propagate; test propagated generation; select breeders.	Propagate; test propagated generation; select breeders.	Produce candidate resistant stock for evaluation.
1.A.4. Mite biology as it relates to control. (Erickson, de Guzman, Harbo, Rinderer, Rubink, Spangler)	Screen candidate traits in high & low fecundity stocks.	Conduct crossing tests to measure heritability & genic correlation of traits.	Conduct crossing tests to measure heritability & genic correlation of traits.	Measure combining ability, inheritance patterns, etc.	Incorporate valuable traits into breeding programs; technology transfer.
1.A.5. Mite rearing. (Feldlaufer, Pettis)	Diet composition; membrane development.	Refine diet composition.	Evaluate molting & completion of life cycle.		
1.A.6. Mite resistance to acaricides. (Eischen, Pettis, Shimanuki, Wilson, Elzen)	Define resistance; determine discriminating dose.	Conduct U.S. survey & develop rotational use of control products.	Monitor spread across nation & begin to model major controlling factors.	Continue to monitor incidence & monitor reversal in most affected areas.	Characterize resistance.
1.B. Control of American foulbrood					
1.B.1. Evaluate tylosin. (Kochansky, Pettis, Shimanuki)	Develop detection methods; conduct laboratory tests.	Develop detection methods; Formulate tylosin for field tests (syrup & patty).	Continue field tests of syrup & patty formulations.	Continue field tests, add dusting formulations; obtain residue data.	Provide data to IR-4 for registration.
1.B.2. Evaluate lauric acid. (Feldlaufer, Pettis, Shimanuki)	Field test formulations of lauric acid.	Continue field testing of formulations.	Field test to collect data for FDA registration?	Submit data for FDA registration or terminate.	Transfer technology to beekeepers.
1.B.3. Monitor for Terramycin resistance. (Shimanuki)	Collect samples of AFB; laboratory tests for resistance.	Collect samples of AFB; laboratory tests for resistance.	Determine if resistance increasing; develop action plans.	Evaluate & change action plan as needed.	Transfer technology to beekeepers.
1.C. Control of Other Diseases and Pests					
1.C.1. Develop methods to control chalkbrood. (Feldlaufer, Gilliam, Shimanuki)	Identify/screen candidate compounds in vitro and bee behavior.	Continue in vitro screening. Complete behavioral assays.	Formulate promising compounds; small-scale field testing.	Large-scale field testing.	Technology transfer.
1.C.2. Develop methods to control wax moth. (Feldlaufer, Schmidt, Spangler)	Screen/test candidate compounds in the laboratory.	Evaluate compounds in wax & as fumigants.	Incorporate compounds into foundation.	Field assessment of efficacy.	Continue field assessment.
1.C.3. Parasitic mite syndrome and bee viruses. (Hung, Shimanuki)	Acquisition of virus samples; perform RT-PCR.	Perform RT-PCR & sequencing.	Perform inverse PCR, arbitrary PCR & sequencing.	Sequence analysis.	Develop field detection kit.
1.C.4 Control of Small Hive Beetle (SHB) (Wilson, Pettis)		Identify & screen candidate compounds for efficacy in caged studies; Initiate study on Biology of SHB.	Formulate & develop delivery systems; Field testing; continue studies in Biology.	Continue field testing; continue studies in Biology.	Continue field testing; continue studies in Biology.

D. Projected Milestone Achievements for Strategic Goal 1

- Obtain EPA registration for formic acid gel for the control of parasitic mites (1-3 years).
- Identify and obtain EPA registration for another acaricide other than menthol, fluvalinate and formic acid gel (1-5 years).
- Fully evaluate/release of *Varroa*-resistant bee stock from Russia to U.S. queen breeders (1-5 years).
- Fully evaluate/release of *Varroa* suppression stock (1-5 years).
- Characterize resistance levels of *Varroa* to fluvalinate (1-5 years).
- Evaluate extent of Terramycin resistant problem (1-3 years).
- Identify alternative material for prevention and control of AFB (1-5 years).
- Develop a new economic method to control wax moth (2-6 years).
- Characterize resistance of *Varroa* to fluvalinate (1-5 years).
- Fully evaluate and release *Varroa* suppressive stock (1-5 years).

E. List of Cooperators

American Beekeeping Federation
American Honey Producers Inc.
Apiary Inspectors of America
Assn. De Campesinos de la Biosfera El Cielo, Mexico
Bayer Corporation
California Beekeepers Association
Car-Mac Products, Inc., Houston, TX
California Dept. of Agriculture
CSIRO, Australia
Elanco Corp.
Florida Dept. of Food & Agriculture
Gamber Foundation, Lancaster, PA
Guatemalan Ministry of Agriculture
IR-4 Committee
Louisiana Dept. of Agricult. & Forestry
Louisiana Dept. of Wildlife & Fisheries
Louisiana State University
Mann Lake Ltd., Hackensack, MN
Maryland Department of Agriculture
Mexican Ministry of Agriculture
MOSCAMED – Guatemala
Oregon State University
Pennsylvania State University
Rio Grande Valley Beekeepers Assn.
Rothamsted Experiment Station, Eng.
Russian Academy of Sciences
The Rutgers State University
Scientific Agriculture, Inc., CA
South Dakota Dept. of Agriculture
South Texas Independent School Dist.
Texas A&M University
Texas Beekeepers Assoc.
Terra Nostra , Cidudad Victoria Mexico
USDA-APHIS
Univ. Autonoma de Tamaulipas, Cidudad Victoria, Mexico
University of California
University of Delaware
University of Idaho
University of Minnesota
University of Nebraska
University of Nuevo Leon, Mexico
University of Sydney, Australia
University of Tennessee
University of Tubingen
University of the Western Cape, South Africa
Washington State University
Wellmark Corp.
Y-Tex Corp.

Strategic Goal 2. - Africanized Honey Bee Management

Develop technology to mitigate the impact of the Africanized honey bee.

A. Current Situation

The first Africanized honey bee swarm resulting from range expansion was discovered in Texas in October 1990. Since then, the Africanized honey bee has spread to Arizona, New Mexico, California, and Puerto Rico. The Africanized honey bee caused an increase in reportable stinging incidents resulting in beekeepers experiencing some difficulty in obtaining apiary sites. Additionally, beekeepers must requeen colonies that have been identified as Africanized. This has resulted in an increase in the costs of liability insurance and for managing honey bee colonies for honey production and pollination. The Africanized honey bee continues to be a public health and safety problem.

B. Desired State

Fundamental studies on the population dynamics of the Africanized honey bee and the process of Africanization of European stocks will lead to effective technology for mitigating the impact of AHB and will ensure the safety of the public. Methods to reduce the likelihood of movement of the Africanized honey bee as a result of human activity must be developed.

	Activities	Activity Code*	Location Code**
2	2.A. **Africanized honey bee (AHB)**		
3	2.A.1. Population dynamics of AHB	ME	T,W
4	2.A.2. Mitigating defensive behavior of AHB	E/O	T
5	2.A.3. Control AHB in sensitive areas	E/O	T
	2.A.4. Development rates for EHB and AHB	E/O	T

D. Projected Milestone Achievements for Strategic Goal 2

- Identify factors that contribute to Africanization in managed and feral colonies (1-5 years).
- Develop strategy to mitigate Africanized honey bees (3-6 years).

E. List of Cooperators

American Beekeeping Federation
American Honey Producers, Inc.
Apiary Inspectors of America
Arizona Department of Agriculture
Arizona State University
California Almond Board
California Dept. of Food & Agricult.
Department of Interior – B.L.M.
Department of Interior – National Park Serv.
National Conservancy
USDA – Forest Service
University of Arizona
University of California

C. Operational Plan for Strategic Goal 2. Mitigate Africanized Honey Bee.

Research Approaches	Activities Year 1	Year 2	Year 3	Year 4	Year 5
2.A. Africanized honey bee (AHB)					
2.A.1. Population dynamics of AHB. (Erickson, DeGrandi-Hoffman, Rubink, Schmidt)	Assess AHB gene introgression; determine bee behaviors that impact Africanization.	Establish regional baselines in AHB & non-AHB areas.	Re-measure regional baselines.	Determine need for further monitoring; terminate or continue.	Final report; terminate
2.A.2. Mitigating defensive behavior of AHB. (Erickson)	Continue field testing of aerosol repellents; test candidate formulations.	Test customer formulations.	Complete testing; Initiate registration.	Complete registration of candidate formulations.	
2.A.3 Control of AHB in sensitive areas. (Schmidt)	Evaluate trapping methods.	Continue testing.	Continue testing.	Transfer technology to customers.	Terminate.
2.A.4. Development rates of EHB and AHB queens. (DeGrandi-Hoffman)	Selection of patrilines.	Determine comparative rates.	Continue.	Publish results/terminate.	

Strategic Goal 3. - Enhancement of Bee-Mediated Crop Pollination

Enhance pollination using insect pollinators.

A. Current Situation

There are currently only six insects that are leased or purchased for commercial pollination (honey bees, alfalfa leafcutting bees, alkali bees, bumble bees, blue orchard bees, and horn faced bees). In the U.S., it is estimated that the honey bee is responsible for 90% of all the pollination. This is a precarious situation because the supply of honey bees is threatened by parasitic mites. Efficient and manageable pollinators for cultivated crops must be identified, especially for newly developed crop varieties and changing agronomic practices.

B. Desired State

Methods to propagate and protect pollinators from agricultural chemicals will be based on integrated pest management. The honey bee is a general pollinator and has proven its value to U.S. agriculture over the years. However, the honey bee may not be the most efficient pollinator for all crops. More efficient pollinators must be identified for blueberries, cranberries, carrot seed, and sunflowers.

Activities	Activity Code*	Location Code**
3.A. **Pollination**		
3.A.1. Utilizing *Andrena spp.*, *Colletes spp.* in orchards	ME	B
3.A.2. Utilizing *Osmia spp.* (almond, cherry, apple, avocado, blueberry, cranberry, sunflower)	ME	B,L,T
3.A.3. Utilizing leafcutting bees (alfalfa, canola, carrot, avocado, cranberry)	ME	L,T
3.A.4. Utilizing *A. mellifera* and *Eumegachile pugnata* for hybrid sunflowers	ME	T,L
3.A.5. Utilizing *A. mellifera* and *Megachile rotundata* for hybrid canola	ME	W,L
3.A.6. Utilizing bumblebees for greenhouses (tomato and eggplant) & avocados	ME	L,T
3.A.7. Utilizing carpenter bees for greenhouses	ME	T
3.A.8. Effect of fungicides on pollen germination	ME	W
3.A.9. Characterizing attractiveness of watermelon	ME	T
3.A.10. Improve pollinator service on cranberries	ME	L
3.A.11. Olfactory and visual cues effecting aggregation of bees	ME	L,T

C. Operational Plan for Strategic Goal 3. Enhance Pollination.

Research Approaches	Activities Year 1	Year 2	Year 3	Year 4	Year 5
3.A. **Pollination**					
3.A.1. Utilizing *Adrena spp., Colletes spp.* in orchards. (Batra)	Determine abundance and foraging pattern.	Locate nests & study microhabitats.	Identify collection & continue nest studies.	Modify microhabitats.	Release on crops.
3.A.2. Utilizing *Osmia spp.* (Batra, Bosch, Buchmann, Cane, Kemp)	Survey for native *Osmia spp.* on flowers.	Study developmental biology.	Determine nesting requirements.	Field test.	Release on crops.
3.A.3. Utilizing leafcutting bees. (Bosch, Buchmann, Kemp, Tepedino)	Monitor establishment of leafcutting bee.	Continue studies.to improve establishment	Re-assess alfalfa and canola needs.	Field test.	Demonstration.
3.A.4. Utilizing *A. mellifera* and *Eumegachile pugnata* for hybrid sunflowers. (Erickson, Buchmann, DeGrandi-Hoffman, Shipman)	Identify means of compatible pollen acquisition by honey bees.	Determine competition on resource.	Determine the impact of having both *Apis* and non-*Apis* bees on flower.	Publish results & terminate.	
3.A.5. Utilizing *A. mellifera* for hybrid canola. (Eischen, Tepedino)	Screen cultivars.	Continue screening & conduct exclusion tests.	Continue screening & exclusion tests.	Test value of honey bee & Leafcutting beepollination.	Evaluate certified seed production.
3.A.6. Utilizing bumblebees for greenhouses and avocados. (Buchmann, Bosch, Kemp)	Purchase/collect bumblebee colonies.	Evaluate on greenhouse crops.	Continue & compare with mechanical sonication.	Test colony management methods.	Technology transfer.
3.A.7. Utilizing carpenter bees for greenhouses. (Buchmann)	Collect wild nests.	Collect additional nests.	Transfer to artificial domiciles.	Evaluate domiciles.	Test on greenhouse tomatoes.
3.A.8. Effect of fungicides on pollen germination. (Eischen)	Develop laboratory assay.	Screen fungicides used on almond blossoms.	Field test fungicides singly & in combination.	Recommend schedule for fungicides to reduce effects.	Expand study to cantaloupes.
3.A.9. Characterizing attractiveness of watermelon. (DeGrandi-Hoffman, Erickson)	Identify attractiveness factors.	Examine combined attractiveness of odor & nectar.	Determine heritability of attractiveness factors.		
3.A.10. Improve pollinator service on cranberries. (Logan Lab.)	Compare pollination efficiency of bees at cranberry.	Determine pollination thresholds for fruit set and size.	Optimize honey bee pollination efficiency.	Explore management methods for alternate bees.	Technology transfer.
3.A.11. Olfactory and visual cues effecting aggregation of bees. (Cane, Kemp, Schmidt)	Observe and collect samples.	Behavioral and chemical analysis.	Behavioral and chemical testing in lab.	Behavioral and chemical testing in field.	Continue field testing.

D. Projected Milestone Achievements for Strategic Goal 3

- Deliver a management system for alfalfa leafcutting bees which reduces losses to pollen boll and chalkbrood (1-5 years)
- Develop a management system for utilization of *Osmia lignaria* for orchard pollination (1-5 years).
- Identify and develop a management system to utilize solitary bee species for blueberry and cranberry pollination (1-5 years).
- Identify candidate pollinators for row crop (carrots, sunflowers, onions, etc.) pollination systems (3-8 years).
- Develop a management system for orchard pollination utilizing *Osmia cornifrons* (1-5 years).
- Evaluate the role of *Apis mellifera* and *Eumegachile pugnata* for the pollination of sunflowers (1-5 years).
- Develop an optimal portfolio of *Apis* genotypes and native bees to maximize cranberry pollination (1-5 years).

E. List of Cooperators

American Beekeeping Federation
American Honey Producers, Inc.
American Museum of Natural History
Arizona State University
Arizona Sonora Desert Museum
Auburn University
California Avocado Commission
International Pollination Systems
Intermountain Canola
Georgetown University
Nature Conservancy
NW Alfalfa Seed Growers Assn., Inc.
Ocean Spray Cranberries, Inc.
Oregon State University
Rutgers Blueberry/Cranberry Research Center
Smithsonian Institution
University of Arizona
University of Idaho
University of Maine
University of Vermont
Utah State University
Washington State University

Strategic Goal 4. - Improve Bee Management

Bee management to increase the profitability of managing *Apis* and non-*Apis* bees for pollination and honey production.

A. Current Situation

The ratio of female to male alfalfa leafcutting bees has decreased over the years for undetermined reasons and because of chalkbrood, and other enemies such as *Pteromolus spp.* and *Monoclontomeris spp.* Such losses have increased the cost of pollination. New methods must be developed to ensure the preservation of genetic resources and pollinator conservation. In addition to preserving germplasm, methods to remove and replace honey bee queens need to be improved. The cost of requeening colonies must be reduced to increase the utilization of queens from mite-resistant stock. Insecticides continue to be a serious problem among beekeepers and methods to protect the Nation's pollinator resources must be developed.

B. Desired State

The cost of pollination and honey production has been increasing over the years because of mites, AHB, pesticide losses and other management problems. Some problems such as mite caused losses, pesticide losses, and requeening costs need to be reduced to increase profitability of pollination and honey production.

Activities	Activity Code*	Location Code**
4A. Management		
4.A.1. Enhance production of alfalfa leafcutting bees and alkali bees	ME	B,L
4.A.2. Preserving pollinator genetic resources	ME	B,L,T
4.A.3. Maintain honey bee colony viability	HR	B,T,W
4.A.4. Reduce insecticide losses	ME	T,W
4.A.5. New methods to requeen honey bee colonies	ME	BR,T,W
4.A.6. Improve nutrition knowledge	ME	B,T
4.A.7. Improve honey bee germplasm preservation methods	ME	B
4.A.8. Improve bee breeding methods	E/O	BR,L
4.A.9. Improve honey beewinter survival by syrup feeding	ME	T

C. Operational Plan for Strategic Goal 4. Improve Bee Management.

Research Approaches	Activities Year 1	Year 2	Year 3	Year 4	Year 5
4.A. Improve Bee Management					
4.A.1. Enhance production of leafcutting bees and alkali bees. (Bosch, Cane, Kemp)	Study mortality factors.	Identify causes.	Identify causes.	Demonstrate/test new management practices.	Demonstrate/test new management practices.
4.A.2. Preserving pollinator genetic resources. (Buchmann, Griswold, Tepedino)	Prepare demonstrations on native pollinators and habitats.	Prepare popular articles on preserving resources.	Continue demonstrations and preparation of popular articles connecting the importance of habitat maintenance and the preservation of native pollinator populations.		
4.A.3. Maintain honey bee colony viability. (Erickson, Hung, Shimanuki, vacancy)	Organize team and make assignments for queen, stress, PMS, pesticide, etc. research.				
4.A.4. Reduce insecticide losses. (Eischen, Elzen, Erickson, Wilson)	Identify problem; cage studies.	Evaluate colony impact.	Develop techniques to reduce losses.	Modify bee management.	Technology transfer.
4.A.5. New methods to requeen colonies. (Danka, Rubink, Shipman, Spangler)	Develop methods to trap queens.	Combine traps/pheromones.	Field test trapping methods.	Continue field tests	Technology transfer.
4.A.6. Improve nutrition knowledge. (Gilliam, Schmidt, Tepedino)	Cage study to increase worker longevity; assess mortality, growth, etc. in leafcutting bees on non-legume crops.	Increase worker longevity; continue to assess mortality, growth, etc.	Design field test to test worker longevity; continue to assess mortality, growth, etc.	Field test in different climates; continue to assess mortality, growth, etc.	Release recommendations.
4.A.7. Improve germplasm preservation methods. (Collins)	Embryo preservation by freezing.	Test *Drosophila* preservation protocol.	Test diluents for semen.	Adapt methods for queen producers.	Technology transfer.
4.A.8. Improve non-*Apis* breeding methods. (Tepedino)	Test single generation strain of alfalfa leafcutting bee under Arizona conditions.	Cross those remaining in diapause for entire year.	Test single generation progeny under variable conditions.	Continue selection process.	Continue selection process; technology transfer.
4.A.9. Improve winter survival by syrup feeding. (Schmidt)	Cage study of toxic effects of syrup breakdown products.	Determine economic threshold for toxicity.	Investigate stabilizers.	Test syrup stabilizers and heat.	Technology transfer & terminate.

D. Projected Milestone Achievements for Strategic Goal 4

- Organize and assign personnel for determining factors contributing to loss of honey bee colony viability (1-3 years).
- Develop new honey bee queen finding methods (1-5 years).
- Evaluate cryopreservation as a means for preserving honey bee semen, eggs and embryo of honey bees (1-5 years).
- Develop techniques to mitigate bee losses to pesticides (1-5 years).
- Increase the survivability of alfalfa leafcutting bees (1-5 years).
- Develop molecular probes for the identification of bee viruses (1-3 years).
- Develop recommendations to optimize drone production regardless of *Varroa* in queen bee mating yards (3-10 years).

E. List of Cooperators

American Beekeeping Federation
American Honey Producers, Inc.
Arizona State University
Asgrow Seed Co.
CSIRO
Department of Interior - BLM
Department of Interior -NPS
Intermountain Canola
International Pollination Systems
Georgetown University
Mann Lake Corp.
Nature Conservancy
NW Alfalfa Seed Growers Assn., Inc.
Oregon State University
Rothamsted Experimental Station
Smithsonian Institution
University of Arizona
University of Guelph
University of Idaho
University of Maine
University of Rochester
Utah State University
Washington State University
USDA Forest Service
Xerces Society

Strategic Goal 5. - Provide Service Needs

Provide services for customers, beneficiaries, stakeholders, and partners.

A. Current Situation

Reductions in state and federal extension programs have led to a reduction in the implementation of ARS Bees and Pollination Research. Reductions in state services in bee disease inspection has increased the need for the ARS to provide a bee disease diagnostic service, emergency AHB identification service and the identification of non-*Apis* bees. The computerization of the National Agricultural Library Bee Bibliography is almost complete. This Bibliography is the oldest in the English language and in its present format is available to only a few users.

B. Desired State

Identification services for bee diseases, AHB and non-*Apis* bees will continue to be provided at no cost to ARS customers and an on-line illustrated key to bee genera will be developed. The research and service entities should also provide training in identification of bee diseases as a means of reducing ARS efforts. The Bee Bibliography should be accessible to customers, beneficiaries, stakeholders, and partners via the internet.

Activities	**Personnel**
5.A.1. Ensure timely transfer of new technologies (ME)	All ARS Bee Research Scientists
5.A.2. Provide identification of bee diseases (O/E)	Shimanuki [B]
5.A.3. Provide emergency identification of AHB (O/E)	Collins [B]
5.A.4. Provide identification of non-A*pis* bees (O/E)	Griswold [L]
5.A.5. Release ARS Bee Bibliography (O/E)	Shimanuki [B]
5.A.6. Estab. international listserv for bee biologists (O/E)	Cane [L]

C. Objectives/Tasks (No Operational Plan for Goal 5)

D. Projected Milestone Achievements for Strategic Goal 3

- Provide timely transfer of newly developed technology (ongoing).
- Release the ARS Bee Bibliography to the public (1-3 years).

E. List of Cooperators

American Beekeeping Federation
American Honey Producers, Inc.
Apiary Inspectors of America
Animal and Plant Health Inspection Services
Arizona Department of Agriculture
California Department of Food and Agriculture
Florida Department of Food and Agriculture
Maryland Department of Agriculture
Smithsonian Institution

Appendix 1: Workshop Agenda

ARS National Bee Research Program Review

Beltsville Agricultural Research Center
Beltsville, Maryland
November 12, 1996--Bldg. 011A Conference Room
November 13, 1996--Bldg. 010A Conference Room

Tuesday, November 12, 1996

Chair, Morning Session ..... H. Shimanuki

8:00AM Registration and Coffee
8:30AM Welcome ..... R. Reginato
8:45AM Objectives of the Program Review ..... K. Narang
Overview of ARS Bee Research Program

9:15AM "Overview of Bee Research at the Beltsville Bee Research Laboratory (BRL)" ..... H. Shimanuki
9:30AM "Bee Mites and Diseases Research at BRL" ..... M. Feldlaufer
9:45AM "Research at the Carl Hayden Bee Research Center, Tucson, AZ" ..... E. Erickson
10:10AM Coffee Break
10:25AM "Research at the Honey Bee Breeding, Genetics, & Physiology Research Lab., Baton Rouge, LA"..... H. A. Sylvester
10:40AM "*Varroa* Mite Research, Baton Rouge, LA" ..... T. Rinderer
10:55AM "Research at the Honey Bee Research Unit, Weslaco, TX" ..... W. Wilson, W. Rubink
11:25AM "Research at the Bee Biology & Systematics Research Unit, Logan, UT" ..... P. Torchio
11:50PM Lunch

Chair, Afternoon Session ..... W. Wilson
Presentations by Invited Representatives from Industry

1:20PM "American Beekeeping Federation Perspectives on Honey Bee Research Needs" ..... T. Fore
1:30PM "Problems and Concerns of a Commercial Beekeeper" ..... R. Adee
1:40PM "Research Needs Unique to Beekeepers in the Southern U.S." ..... B. Merritt
1:50PM "Bee Research Priorities of the American Honey Producers" ..... J. Cole
2:00PM "Researchable Problems of the Migratory Beekeeper" ..... D. Hackenberg
2:10PM "Research Priorities of the Apiary Inspectors of America" ..... I. B. Smith
2:20PM "An Industry Viewpoint of Crop Pollination by Bees" ..... R. Bitner
2:30PM "Perspectives of Bee Research from the Idaho Seed Commission" ..... C. Baird
2:40PM "Agriculture's Priorities for Bee Research" ..... S. Rawlins
2:50PM Coffee Break
3:05PM "Perspectives of Bee Research from the Almond board of California" ..... C. Heintz
3:15PM "Getting the Most for Your Research Dollars and How Do We Accomplish This" ..... B. Brooks
3:25PM "Need for Short-term Action for Pesticide Approval" ..... P. Lantz
3:35PM "Research Needs of the National Plant Board" ..... W. Gimpel
3:45PM "Eastern Apicultural Society" ..... D. Caron

Discussion Session - Input from Customers and Stakeholders on needs and priorities.
3:55PM Discussion Area 1: What areas of bee research will be important in the next 5 - 10 years?
Discussion Leader ..... H. Shimanuki
Rapporteur ..... W. Wilson
5:00PM Closing Return to Hotel

Wednesday, November 13, 1996

Discussion Session - Input from Customers and Stakeholders on needs and priorities (Continued)
8:00AM Discussion Area 2: What are the major strengths of the present ARS Bee Research Program?
Discussion Leader .... T. Rinderer
Rapporteur .... P Torchio
9:00AM Coffee Break
9:15AM Discussion Area 3: What areas of research should be emphasized by ARS researchers in the next 5- 10 years?
Discussion Leader..... E. Erickson
Rapporteur ..... H. A. Sylvester
10:15AM Discussion - Miscellaneous Issues: Bee research funding, Natl. and Intl. coordination, etc.
10:45AM Summary Reports of Discussion Sessions (10- 15 minutes per area)
The Rapporteur of each session will provide a 10-minute summary/report of the customer input. (A written summary will be developed by the Steering/Organizing Committee and will be sent in a follow-up letter to all attendees.)
12:00PM Closing Remarks ..... K. Narang

Appendix 2: STEERING COMMITTEE

Hachiro Shimanuki, Chairman

Eric Erickson

Thomas Rinderer

Philip Torchio

William Wilson

S. Karl Narang, National Program Leader

Appendix 3: Workshop Participants

Richard Adee
American Honey Producers Assoc.
Bruce, SD

Scott Angle
Agr. Exp. Sta.
College Park, MD

Craig Baird
University of Idaho
Parma, ID

Ron Bitner
International Pollination Systems
Caldwell, ID

Dan Breauz
American Bee Breeders Assoc.
Tampa, FL

Robert Brooks
Perkiomen Valley Apiaries, Inc.
Obelisk, PA

Al Carl, Jr.
Mass. Apiary Inspector
Amherst, MA

Dewey Caron
Eastern Apicultural Society
University of Delaware
Newark, DE

Jerry Cole
Bosque Honey Farm, Inc.
Bosque Farms, NM

Keith Delaplane
Assoc. of Prof. Apiculturists
Athens, GA

Robert Flanders
APHIS, PPQ, BATS
Riverdale, MD

Troy Fore
American Beekeeping Federation
Jesup, GA

Glenn Gibson
American Honey Producers Assoc.
Minco, OK

William Gimpel, Jr.
National Plant Board
Annapolis, MD

Jessica Goldstein
National Public Radio
Washington, D.C.

David Hackenberg
American Beekeeping Federation
Lewisburg, PA

Chris Heintz
Almond Board of California
Modesto, CA

Carolyn Jensen
National Public Radio
Washington, D.C.

Paul Lantz
Beekeeper
Powell, TN

Naima Mansur
Burtonsville, MD

William Merritt
American Beekeeping Federation
Sopchoppy, FL

Kathy Montgomery
United Fresh Fruit & Veg. Assoc.
Alexandria, VA

David Morris
MD Beekeepers Assoc.
Laurel, MD

Kim Putens
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Appendix 4: CRIS Units

1275-21000-073-00D	Utilization of non-*Apis* bees for the pollination of horticulture, small fruit, and vegetable crops. (Beltsville)
1275-21000-081-00D	Diagnosis and control of diseases of honey bees. (Beltsville)
1275-21000-125-00D	Integrated pest management of parasitic mites of honey bees. (Beltsville)
1275-21220-025-00D	Honey bee germplasm: diversity and preservation. (Beltsville)
5342-21000-009-00D	Biology of feral Africanized honey bees and European honey bees in the arid Southwest. (Tucson)
5342-21000-010-00D	Improvement of honey bee pollination of fruit and seed crops and ecologically important plant species. (Tucson)
5428-21000-008-00D	Biology and development of alternative crop pollinators. (Logan)
5428-21000-003-22S	Utah State University: Characterization & Evaluation of Four Bacteria as Biological control Agents of *Ascosphaera*. (Logan)
5428-21000-008-20S	Oregon State University: Studies in Genetics, Development & Environmental Physiology of *Megachile rotundata* & *M. apicalis*. (Logan)
5428-21000-003-23S	Washington State University: Immature Mortality of Leafcutting Bees. (Logan)
5428-21000-008-24S	University of Idaho: Management of Leafcutting Bees and Pests of Alfalfa Seed. (Logan)
5428-21000-008-02R	The Nature Conservancy: Survey of the Rare Bees of Clark County. (Logan)
5428-21000-008-01R	The Nature Conservancy: Pollination and Genetic Diversity of Rare Clonal Buckwheat *Erirgonum ovalitolium* Var. *williamsiae*. (Logan)
6204-21000-007-00D	Parasitic mite control in honey bee colonies utilized in honey production and crop pollination. (Weslaco)
6413-21000-004-00D	Breeding and genetic approaches to tracheal mites, Africanized bees, and honey bee stock improvement. (Baton Rouge)
6413-21000-005-00D	Control of the honey bee parasite, *Varroa jacobsoni* through breeding and novel methods of management. (Baton Rouge)

Appendix 5: List of Significant Cooperators

American Beekeeping Federation
American Honey Producers Association
Animal and Plant Health Inspection Services
Apiary Inspectors of America
Arizona State University
BARD
Bayer Corp.
California Almond Board
California Beekeepers Association
California Department of Food and Agriculture
Cornell State University
CSIRO, Australia
Dr. Sean Davison - Bellville, South Africa
Department of Interior – B.L.M.
Department of Interior – National Park Service
Elanco Corp.
Florida Department of Food & Agriculture
Gambers Foundation
Georgetown University
International Pollination Systems
IR-4 Committee
Louisiana Department of Agriculture and Forestry
Louisiana Department of Wildlife and Fisheries
Louisiana State University
Maryland Department of Agriculture
MOSCAMED, Guatemala
National Academy of Sciences – Russia
National Conservancy
National Institutes of Health
Oregon State University
Pennsylvania State University
Rio Grande Valley Beekeepers Assoc.
Rothamsted Experimental Station, England
Russian Academy of Sciences
The Rutgers State University
Scientific Agriculture Inc., California
Simon Fraser University
Smithsonian Institute
Texas A&M University
University of Arizona
University of California
University of Delaware
University of Florida
University of Guelph
University of Idaho
University of Maine
University of Minnesota
University of Nebraska
University of Sydney
University of Tennessee
University of Tubingen, Germany
University of Vermont
University of Western Cape, South Africa
University of Wisconsin
University of Rochester
USDA Forest Service
Utah State University
Washington State University
Wellmark Inc.
Y-Tex Corp.